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Differences in ERP use and value across Iberian Manufacturing and Services SMEs

Jorge Miguel da Silveira Rebelo

Dissertação apresentada como requisito parcial para obtenção do grau de Mestre em Gestão de Informação

UNIVERSIDADE NOVA ISEGI

Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

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Dissertação apresentada como requisito parcial para a obtenção do grau de Mestre em Gestão de Informação, Especialização em Gestão de Sistemas e Tecnologias de Informações

Dissertação Orientada por,
Mestre Pedro Miguel Fernandes Ruivo
Professor Doutor Tiago André Gonçalves Félix de Oliveira

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RESUMO

A literatura sobre os Sistemas Integrados de Gestão Empresarial (ERP) reporta muito poucos estudos sobre os estádios de pós-adoção, ou seja, o uso efetivo e o valor. Ainda menos estudos se focam nas especificidades de uma análise por sector de atividade. Com base no Contexto de Inovação Tecnológica (TOE framework) e na teoria da Visão Baseada em Recursos (RBV theory), desenvolvemos um modelo de investigação para medir e examinar os determinantes do uso e valor dos ERP e o seu impacto na região Ibérica (Portugal e Espanha), em empresas de Serviços e Indústria de Pequena e Média dimensão (SMEs). O teste empírico foi conduzido através da modelação de equações estruturais, com recurso a dados de 261 empresas na Península dos sectores de Serviços e Indústria. Os resultados mostram que entre os determinantes do uso de ERP, o Treino é o mais importante para os Serviços, enquanto a Compatibilidade é mais importante para a Indústria. O Tamanho da Empresa, as Capacidades Analíticas e a Colaboração contribuem para o valor dos sistemas ERP em ambos os sectores, com a Capacidade Analítica a ser mais importante para os Serviços. Este estudo permite conhecer quais os determinantes mais importantes para o uso e valor dos sistemas ERP nas Pequenas e Médias Empresas Ibéricas de Serviços e Indústria, oferecendo implicações académicas e de gestão.

PALAVRAS-CHAVE

Sistemas Integrados de Gestão Empresarial, uso do ERP, valor do ERP, Indústria, Serviços, Pequenas e Médias Empresas, Contexto de Inovação Tecnológica, Visão Baseada em Recursos.

ABSTRACT

Enterprise Resource Planning (ERP) system literature reports very little research on post-adoption stages, that is, actual usage and value. Even fewer studies focus on the specificities of an industry analysis. Based on the Technology-Organizational-Environment (TOE) framework and the Resource-Based View (RBV) theory, we develop a research model to measure and examine determinants of ERP use and value and their impact in the Iberian region (Portugal and Spain) across Manufacturing and Services industries in Small and Medium Enterprises (SMEs). The empirical test was conducted through structural equation modelling, using data from 261 firms in the peninsula in the Manufacturing and Service industries. Results show that amongst ERP use determinants, Training is the most important determinant for Service firms and Compatibility for Manufacturing firms. Firm size, Analytics, and Collaboration contribute to ERP Value in both industries, with Analytics being more important for the Service industry. The paper provides insight into which determinants contribute to ERP use and ERP value in Iberian Manufacturing and Services SMEs, offering managerial and academic implications.

KEYWORDS

Enterprise Resource Planning (ERP), ERP use, ERP value, Manufacturing, Services, SMEs, Technology-Organizational-Environment, Resource-Based View.

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ABBREVIATIONS

ERP	Enterprise Resource Planning
TOE	Technological-Organizational-Environmental framework
RBV	Resource-Based View theory
SME	Small and Medium Sized Enterprise
IS	Information Systems
IT	Information Technology
CEO	Chief Executive Officer
CFO	Chief Financial Officer
SEM	Structured Equation Modeling
PLS	Partial Least Square
AVE	Average Variance Expected
R^2	R-Square

1. INTRODUCTION

Enterprise Resource Planning (ERP) systems have been applied by many firms around the world as a key part of the organizational infrastructure. ERP encompasses a wide range of software products supporting day-to-day business operations and decision-making (Singla, 2008). ERP systems are expected to provide seamless integration of processes across functional areas with improved workflow, standardization of various business practices, improved order management, accurate accounting of inventory, and better supply chain management (Aier, Bucher, & Winter, 2011; Mabert, Soni, & Venkataramanan, 2003). The ERPs are particularly important for manufacturing and services in Small and Medium Enterprises (SMEs) (Botta-Genoulaz & Millet, 2006; Raymond & Uwizeyemungu, 2007).

The current process of structural change in Europe is one in which the share of manufacturing in the economy is declining while services are accounting for increasing shares of employment and value added (Castaldi, 2009). The manufacturing and service industries are still the two main economic activities in the European Union (Johansson, 2008; Schmiemann, 2008). Several authors (Ramdani, Kawalek, & Lorenzo, 2009; Ruivo, Oliveira, & Neto, 2012; Taylor & Murphy, 2004) state that SMEs are the backbone of Europe's economy, important for increasing productivity and gaining competitive advantage in the global economy, as well important drivers of innovation and transformation. Literature reveals that little attention has been given to research on ERP in SMEs, and even less on specific industries such as manufacturing and services (Haddara & Zach, 2011). To fill the gap, this paper addresses the following research question in the SME context: What are the drivers and differences in ERP use and value between manufacturing and services industries?

To answer this question we developed a conceptual model based on the Technology-Organization-Environment (TOE) framework to explain ERP use and Resource Based View (RBV) theory to explain ERP value. To test the conceptual model we collected data of SMEs from the Iberian Peninsula region across manufacturing

(158 firms) and service (103 firms) industries. Theoretical perspectives are presented next, then in Section 3 the research model and hypotheses are explained**.** The methodology is presented in Section 4, followed by results, discussion and a conclusion.

2. THEORETICAL PERSPECTIVES

2.1. ERP ADOPTION IN MANUFACTURING AND SERVICES FIRMS

While ERP systems have traditionally been used by capital-intensive industries such as manufacturing, they have recently been implemented in the service industry (Botta-Genoulaz & Millet, 2006). As far as ERP is concerned, service organizations were not initially targeted by many ERP vendors, which instead developed products for manufacturing companies (Botta-Genoulaz & Millet, 2006). However, ERP systems are increasingly being implemented in the service industry (Empson, 2001).

It has been argued that the industry in which the firm operates influences the adoption of Information System (IS) innovations (Levenburg, Magal, & Kosalge, 2006). Recent findings reveal that in the European context the most important feature to characterize Information Technology (IT) adoption is the industry and its specific characteristics rather than the country the firms belong to (Oliveira & Martins, 2010a).

The service industry is quite unlike the manufacturing industry (Kathawala & Abdou, 2003). The growth of services in the European Union 27 countries raises questions about the adequacy of our understanding of innovation activities in service-dominated economies, especially as innovation is regarded as fundamental to the competitiveness of advanced economies (Commission, 2009). Different industries have different operating characteristics and environments, and the factors related to ERP use and value may differ accordingly (Oliveira & Martins, 2010b; Ruivo et al., 2012). Given the distinct nature of the offerings of manufacturing and services firms, differences in the use and value may be very plausible. Thus, it is expect that there will be systematic differences between industries in the actual use of ERP systems and related value creation.

2.2. ERP USE AND THE TOE FRAMEWORK

One of the most important adoption models at the firm level is the TOE framework (Oliveira & Martins, 2011; Tornatzky & Fleischer, 1990). This framework will be used to explain ERP use, since it is a well-established one that encompasses various contexts with which IT adoption can be assessed, and it has been examined in a number of studies on various IS domains (Raymond, Uwizeyemungu, Bergeron, & Gauvin, 2012; Zhu & Kraemer, 2005). The TOE framework identifies three aspects of a firm's context that influence the process by which it adopts, implement, and uses technological innovation: (a) Technological context – which describes both the internal and external technologies relevant to the firm; (b) Organizational context – which refers to descriptive measures about the firm; and (c) Environmental context – which refers to the arena in which a firm conducts its business (Tornatzky & Fleischer, 1990).

2.3. ERP VALUE AND RBV THEORY

The RBV theory remains the dominant theoretical explanation of IT business value, as IS researchers have employed the resource perspective to expand and deepen our understanding of IT business value (Bharadwaj, 2000; Clemons & Row, 1991; Schmidt, Erek, Kolbe, & Zarnekow, 2009). The RBV theory sustains that a firm creates value by combining heterogeneous resources that are economically valuable, difficult to imitate, or imperfectly mobile across firms (Barney, 1991; M. Peteraf, 1993). In the IS literature the RBV has been used to analyse how IT business value can be explained by IT capability as a resource (Ross, Beath, & Goodhue, 1996; Zhu & Kraemer, 2005). Thus, an ERP system business value depends on the extent to which ERP systems are used in the key activities in the firm's value chain (Ruivo et al., 2012; Zhu, Kraemer, & Dedrick, 2004). The creation of value requires the capabilities to effectively use the ERP system in the post implementation phase (Jain, 2010). Several studies have concluded that ERP systems can lead to sustained, competitive advantages (Fosser, Leister, Moe, & Newman, 2008; Hedman & Kalling, 2003). In line with the RBV theory,

the present study will take into account several variables that can be perceived by firms as valuable assets, to better understand how those assets can be used to improve business performance and thereby to extract value from the ERP system.

3. RESEARCH MODEL AND HYPOTHESES

3.1. THE RESEARCH MODEL

The extent of ERP use by an organization will be influenced by its technological, organizational, and environmental contexts within the TOE framework (Zhu & Kraemer, 2005). The determinants of ERP use are: Training, Compatibility, Firm Size, Best Practices, and Competitive Pressure. The RBV theory is used to understand ERP value. RBV suggests that the greater the extent of IT use, the greater the likelihood that organizations will create IT capabilities that are rare, inimitable, valuable, and sustainable. Also, ERP helps companies to develop appropriate functionalities to leverage business performance, thereby contributing to value creation. It is hypothesized that an ERP value is explained by four determinants: ERP use, Collaboration, Analytics, and Firm Size. A conceptual model was developed to assess the use and value of ERP systems (Figure 1).

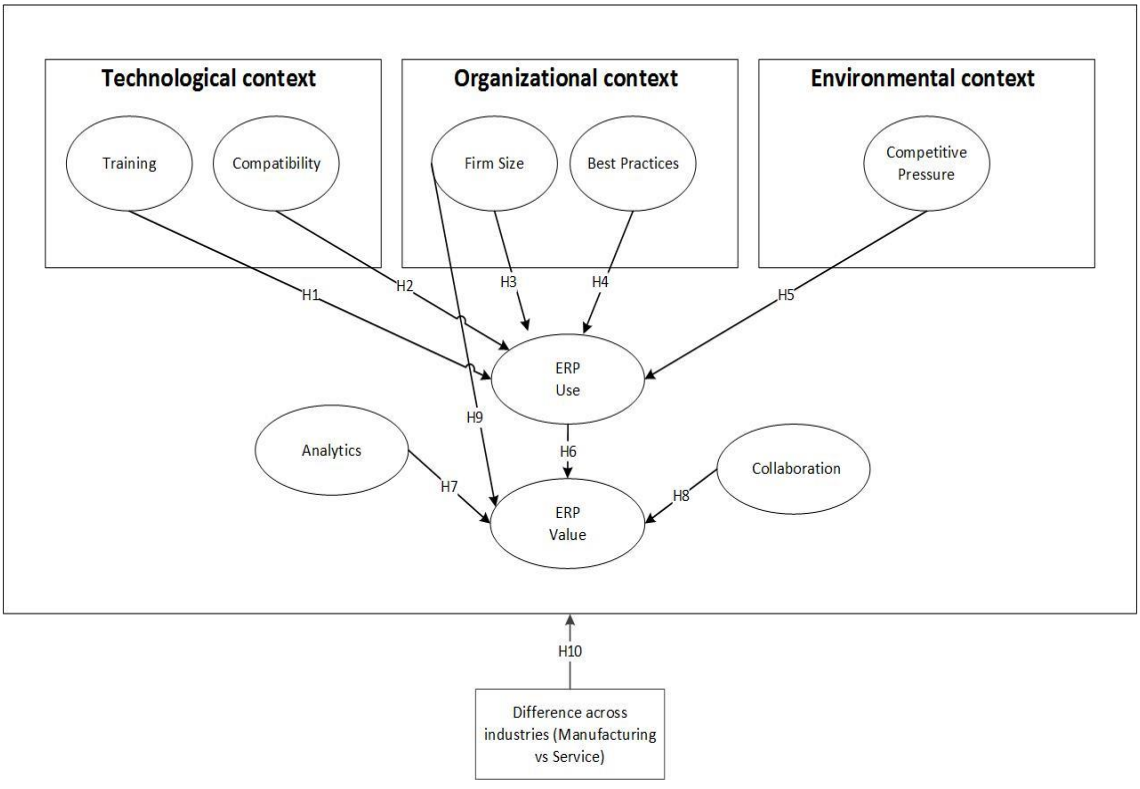

Figure 1 – The research model

3.2. HYPOTHESES TO EXPLAIN ERP USE

Technology Context

According to Tornatzky and Fleischer (1990) a firm with higher quality human resources, such as better education or training, will have greater ability in technological innovation. Literature shows that training is an important factor for IT implementation success (Gupta, 2000), and furthermore for successfully adopting, using, and benefiting from ERP systems (Bradford & Florin, 2003; Maguire, Ojiako, & Said, 2010; O'Leary, 2000). We therefore postulate that training increases the ability to use an information system application.

H1. The level of a firm's training programme will have a positive relationship with ERP use.

On the technical side of IT, one of the primary reasons for the inability of many firms to realize the full potential offered by IT is the incompatibility amongst the various computer hardware and software systems (Rajagopal, 2002). Compatibility has been shown to be an important factor in explaining innovation use by organizations, and high compatibility has been identified as a facilitator for innovation utilization (Cooper & Zmud, 1990; Zhu et al., 2004). The findings of Bradford and Florin (2003), and Elbertsen and Benders (2006) indicate that the degree of compatibility of ERP systems with existing IT infrastructure has a positive relationship with successful adoption and use.

H2. Firms having ERP systems with greater compatibility are more likely to use ERP.

Organizational Context

Firm Size is one of the most commonly studied factors in the innovation literature (Damanpour, 1992). Larger firms have an advantage over smaller ones, as they have more resources and can take greater risks associated with innovation

adoption (Thiesse, Staake, Schmitt, & Fleisch, 2011). Since our study focuses on SMEs, we postulate that smaller firms are characterized by a resource poverty resulting from various severe constraints, which is a barrier for ERP use.

H3. Larger firms tend to achieve a greater extent of ERP use.

From the business process reengineering perspective, there are two ERP implementation options: modify (customize) the ERP package to suit the firm's requirements (with high costs), or implement an ERP package with minimum deviation from the standard settings (with lower costs) (Davenport, 1998; Ruivo et al., 2012). Standard packages can increase development speed, reduce development staff requirements, and offer a constant state-of-the-art IT capability through upgrades (Light, Holland, & Wills, 2001). Thus, the business processes implied in the ERP system are understood to represent "best practices" and a more competitive business model (Light et al., 2001). Literature shows that firms that implement industry best-practices dramatically reduce risk and time-consuming project tasks such as configuration, documentation, and testing (Maguire et al., 2010; Ruivo et al., 2012).

H4. Firms with a greater degree of business process fit to standard ERP "best-practices" are more likely to use ERP.

Environment Context

Competitive pressure refers to the degree of pressure from competitors, which is an external power pressing a firm to adopt new technology in order to avoid competitive decline (Zhu et al., 2004). It has long been recognized as a driving force for new technology use, as it tends to press companies to seek competitive edge by adopting new practices (Gatignon & Robertson, 1989). Several studies have determined Competitive Pressure to be an IT adoption and use driver (Oliveira & Martins, 2011; Zhu & Kraemer, 2005; Zhu, Xu, & Dedrick, 2003).

H5. Firms facing higher competitive pressure are more likely to achieve a greater extent of ERP use.

3.3. HYPOTHESES TO EXPLAIN ERP VALUE

Based on the strategic management literature, the RBV of the firm posits that firms create value by combining heterogeneous resources that are economically valuable (Barney, 1991; Schoemaker & Amit, 1994), difficult to imitate (Barney, 1991; Peteraf, 2006), rare (Barney, 1991), and non-substitutable (Barney, 1991). IT business value depends on the extent to which IT is used in the key activities in the firm's value chain. The greater the use, the more likely the firm is to develop unique capabilities from its core IT infrastructure (Zhu et al., 2004). System use is essential for ERP to generate any impact on firm performance, and a strong link can therefore be established between system use and system impact (DeLone & McLean, 1992; Devaraj & Kohli, 2003; Zhu & Kraemer, 2005).

H6. Firms with greater ERP use are more likely to generate higher ERP value

A number of case studies describe business analytics applications and discuss how they might contribute to firm performance (Davenport & Harris, 2007; Piccoli & Watson, 2008). Business analytics systems can potentially contribute to firm performance and create competitive advantage (Davenport & Harris, 2007). According to Bendoly (2003), the adoption of ERP systems has been accompanied by a veritable explosion of readily available transactional data. Those firms that have embedded analytics capabilities into ERP database can easily and quickly use data for managerial decision-making and consequently acquire an advantage in attaining sustainable business performance (Lucas, Babaian, & Topi, 2008; Ruivo & Neto, 2011).

H7. Firms with greater levels of analytical information extracted from ERP are positively associated with higher ERP value.

The literature firmly supports the belief that an organization's implementation of an ERP system shapes its processes, culture, and social system (Conner & Prahalad, 1996; Davenport, 1998). Thus, the organizational culture promoting the free-flow of information and sharing of knowledge amongst employees and across department

lines is important for ERP implementation's success, in the same way that ERP implementation changes the organizational culture promoting the free-flow of information and sharing of knowledge amongst employees and across department lines. ERP systems help users to collaborate, increasing efficiency and effectiveness (Gattiker & Goodhue, 2005; Leimeister, 2010). Thus, it is plausible that firms with greater collaboration are positively associated with higher ERP value

H8. Firms' greater collaboration in ERP systems is positively associated with higher ERP value.

The literature reveals no consensus on the role of firm size in the process of innovation implementation. Larger firms often possess more resources that can facilitate innovation implementation (Thiesse et al., 2011). Smaller firms, although more versatile, are characterized by severe resource constraints and do not readily adopt new technologies (Lippert & Govindarajulu, 2006). Therefore, we postulate that the available resources and the financial capital which larger firms may possess will have a positive impact on the adoption and use of ERP, and as a result, on value creation.

H9. Firm size is positively associated with ERP value.

Sohal et al. (2001) report that manufacturing and service firms are achieving few benefits from their IT investments. The major benefits achieved across both industries have been limited to improvement in productivity and cost reductions. The structure of services are inherently different from manufacturing, and given the distinct nature of the offerings of manufacturing and services firms, different drivers for ERP use and value across the two industries are very plausible.

H10. The antecedents of ERP use and value will differ for Manufacturing and Services Firms.

4. METHOD

4.1. MEASUREMENT

The constructs were operationalized on the basis of a literature review (Appendix A). Constructs were measured using a survey instrument. Whereas the ERP use construct was measured by items calling for responses in percentages, all other constructs were measured using a five-point Likert scale, with the anchors being “low” and “high”. A survey methodology is proposed for data collection to validate the research model and test its ten hypotheses. The questionnaire was elaborated in English as suggested in the literature and each survey item-question was translated into the two languages and reviewed for content validity by a panel of five established academic IS researchers and two language experts. The initial questionnaires were pilot tested on thirty firms, and some items were revised for clarity. To ensure the generalization of the survey results, the sampling was stratified by country (Portugal and Spain), by firm size (10-50 employees and 50-250 employees, that represent respectively small and medium size firms, in accordance with the European definition of SMEs (Commission, 2005), and by industry (manufacturing and services). The control variables used were country and industry type.

4.2. PARTICIPANTS AND DATA COLLECTION

With the assistance of International Data Corporation, data were collected using an online survey over a two-month period (September and October, 2011), resulting in a final sample of 261 companies (158 Manufacturing and 103 Services). The response rate was 39.8%. The respondents were individuals (e.g., Chief Executive Officer (CEO), Chief Financial Officer (CFO), and business managers) who were qualified to speak about the company's ERP system, which suggests a good quality of the data. The profiles of the respondent and sample are shown in Table 1. The sample covered varying types of businesses and represented small (€2 to €10 million) and medium companies (€10 to €50 million), conforming to the European Commission standard for enterprise classification (Commission, 2005).

Table 1 - Sample Characteristics

Respondent Type	**Full Sample** (n=261)	**Manufacturing** (n=158)	**Services** (n=103)
CEO	19.6%	24.1%	12.6%
Manufacturing Manager	18.0%	29.7%	0%
Finance Manager	12.4%	15.2%	7.8%
IT/IS Manager	23.8%	17.1%	34.9%
Sales Manager	26.2%	13.9%	44.7%
Annual Turnover			
€10 to 50 million	46.4%	50.6%	39.8%
€2 to €10 million	53.6%	49.4%	87.4%

Note: The anual turnover is presented in accordance of the European Commission SME definition (Commission. 2005).

5. RESULTS

Structured Equation Modeling (SEM) was used to empirically assess the research model (Figure 1). The Kolmogorov-Smirnov test was performed, confirming that none of the items measured are distributed normally ($p<0.001$). This allows for safe use of Partial Least Square (PLS) for the analysis, at this does not require a normal distribution (Chin, Marcolin, & Newsted, 2003). PLS estimation requires, for reflective constructs, ten times the largest number of structural paths directed at a particular construct in the model (Chin, 1998). The sample in our study met the necessary conditions for using PLS. The specific tool used was SmartPLS 2.0 (Ringle, Wende, & Will, 2005). First, we examined the measurement model to assess reliability and validity before testing the structural model.

5.1. MEASUREMENT MODEL

The results of the measurement model (construct reliability, indicator reliability, convergent validity, and discriminant validity) for full sample are reported in Tables 2 and 3. We also compute these tables for each industry (available from author on request) and the results are similar. The construct reliability was tested using the composite reliability coefficient. PLS prioritizes indicators according to their individual reliability. As shown in Table 2, all the constructs have a composite reliability greater than 0.7, which suggests that the constructs are reliable (Straub, 1989).

Table 2 - Correlation Matrix, Composite Reliability (CR), and square root of AVE

Constructs	CR	TN	CB	FS	BP	CP	EU	AN	CO	EV
Training (TN)	**0.94**	**0.95**								
Compatibility (CB)	**0.92**	0.24	**0.90**							
Firm Size (FS)	**0.91**	0.20	-0.09	**0.92**						
Best-Practices (BP)	**0.81**	0.53	0.28	0.18	**0.83**					
Competitive Pressure (CP)	**0.85**	0.30	0.09	0.37	0.34	**0.80**				
ERP use (EU	**0.83**	0.38	0.34	0.55	0.41	0.46	**0.79**			
Analytics (AN)	**0.86**	0.45	0.17	0.22	0.53	0.32	0.31	**0.82**		
Collaboration (CO)	**0.91**	0.36	-0.11	0.32	0.45	0.27	0.24	0.38	**0.88**	
ERP value (EV)	**0.92**	0.46	0.07	0.49	0.58	0.38	0.42	0.52	0.63	**0.89**

Notes: (1) First column (CR) is Composite Reliability; (2) Diagonal elements are square root of Average Variance Extracted

The indicator reliability was evaluated based on the criteria that the loadings should be greater than 0.70, and that every loading less than 0.4 should be eliminated (Churchill, 1979; Henseler, Ringle, & Sinkovics, 2009). As shown in Table 3, the loadings (in bold) are greater than 0.7. Hence,only four items in the table were eliminated (TN1, BP2, EV1, and EV3). All the items are statistically significant at 0.001. Overall, the instrument presents good indicator reliability.

Average Variance Extracted (AVE) was used as the criterion to test convergent validity. The AVE should be higher than 0.5 in order that the latent variable explains more than half of the variance of its indicators (Fornell & Larcker, 1981; Hair, Sarstedt, Ringle, & Mena, 2012; Henseler et al., 2009). As shown in Table 2, all constructs have an AVE higher than 0.5, fulfilling this criterion.

Discriminant validity of the constructs was assessed using two measures: Fornell-Larcker criteria and cross-loadings. The first criterion postulates that the square root of AVE should be greater than the correlations between the construct (Fornell and Larcker, 1981). The second criterion requires that the loading of each indicator should be greater than all cross-loadings (Chin, 1998; Götz, Liehr-Gobbers, & Krafft, 2010). As seen in Table 2, the square roots of AVE (diagonal elements) are higher than the correlation between each pair of constructs (off-diagonal elements). Table 3 shows that the loadings are greater than cross-loadings. Thus, both measures are satisfied.

Table 3 - Loadings and cross-loadings for the measurement model

Constructs		TN	CB	FS	BP	CP	EU	AN	CO	EV
Training (TN)	TN2	**0.95**	0.27	0.22	0.55	0.28	0.37	0.43	0.33	0.48
	TN3	**0.94**	0.19	0.16	0.45	0.29	0.36	0.43	0.36	0.39
Compatibility (CB)	CB1	0.20	**0.95**	-0.06	0.28	0.06	0.31	0.18	-0.06	0.10
	CB2	0.20	**0.94**	-0.05	0.23	0.10	0.32	0.10	-0.09	0.02
	CB3	0.25	**0.79**	-0.13	0.23	0.10	0.28	0.17	-0.15	0.07
Firm Size (FS)	FS1	0.16	-0.09	**0.91**	0.18	0.35	0.47	0.25	0.33	0.48
	FS2	0.20	-0.07	**0.92**	0.14	0.32	0.54	0.15	0.25	0.42
Best-Practices (BP)	BP1	0.62	0.32	0.07	**0.78**	0.28	0.30	0.51	0.26	0.49
	BP3	0.29	0.16	0.21	**0.87**	0.29	0.38	0.38	0.47	0.48
Competitive Pressure (CP)	CP1	0.30	-0.02	0.31	0.25	**0.83**	0.43	0.26	0.23	0.31
	CP2	0.22	0.23	0.31	0.31	**0.75**	0.36	0.30	0.22	0.32
	CP3	0.19	0.03	0.27	0.28	**0.83**	0.31	0.19	0.19	0.28
ERP use (EU)	EU1	0.08	0.07	0.64	0.04	0.25	**0.70**	0.08	0.14	0.34
	EU2	0.44	0.39	0.32	0.44	0.38	**0.82**	0.30	0.17	0.31
	EU3	0.36	0.34	0.37	0.47	0.46	**0.85**	0.35	0.25	0.34
Analytics (AN)	AN1	0.26	0.09	0.36	0.37	0.32	0.33	**0.78**	0.39	0.44
	AN2	0.44	0.21	-0.02	0.39	0.22	0.22	**0.84**	0.17	0.26
	AN3	0.43	0.13	0.12	0.50	0.23	0.21	**0.83**	0.31	0.50
Collaboration (CO)	CO1	0.37	-0.02	0.32	0.45	0.24	0.31	0.37	**0.94**	0.69
	CO2	0.38	-0.12	0.32	0.45	0.33	0.22	0.32	**0.89**	0.55
	CO3	0.13	-0.23	0.14	0.24	0.09	-0.01	0.30	**0.80**	0.33
ERP value (EV)	EV2	0.46	0.05	0.51	0.58	0.38	0.46	0.47	0.63	**0.94**
	EV4	0.28	0.00	0.57	0.48	0.27	0.37	0.36	0.59	**0.91**
	EV5	0.50	0.16	0.18	0.50	0.36	0.27	0.60	0.44	**0.80**

The assessment of construct reliability, indicator reliability, convergent validity, and discriminant validity of the constructs are satisfactory, indicating that the constructs can be used to test the conceptual model.

5.2. STRUCTURAL MODEL

The analysis of hypotheses was based on the examination of the standardized paths. The significance of the path coefficients was assessed by bootstrapping procedure with 500 times resampling (Chin, 1998; Hair, Ringle, & Sarstedt, 2011; Henseler et al., 2009). Figure 2 shows the standardized path coefficients and statistical significance, as well as the R^2 values for dependent constructs, for both manufacturing (in parentheses) and services (without parentheses) industries.

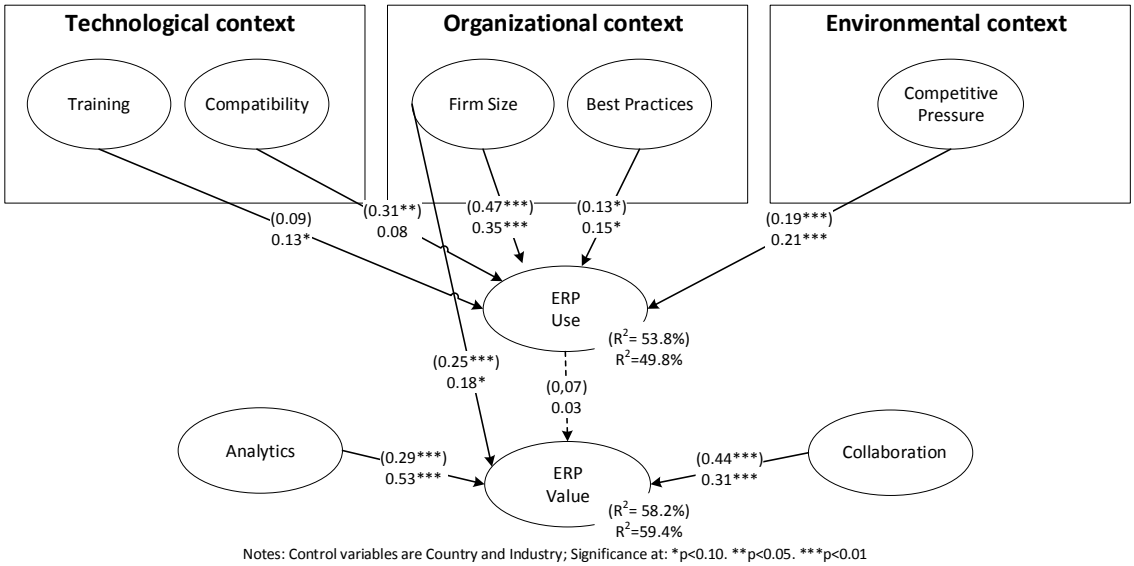

Figure 2 - Conceptual model testing (Manufacturing subsample N=158; Services subsample N=103)

The results for the manufacturing industry, in parentheses, are summarized as follows. An examination of R^2 as a descriptive measure shows that the research model explains 53.8% of variation in ERP use. Within the Technological context, while Training (H1) is not statistically significant ($\hat{\beta} = 0.09;$ p>0.10), the hypothesis for compatibility (H2) ($\hat{\beta} = 0.31$; p<0.05) has a significant and positive path to ERP use. Thus, H2 is confirmed while H1 is not. Within the Organizational context, Firm Size (H3) ($\hat{\beta} = 0.47$;p<0.01) and Best-Practices (H4) ($\hat{\beta} = 0.13;$ p<0.10) are both statistically significant for explaining ERP use, and therefore H3 and H4 are confirmed. Within the Environmental context hypothesis Competitive Pressure (H5) ($\hat{\beta} = 0.19;$ p<0.01) is statistically significant and has a positive path to explain ERP use. Thus, H5 is confirmed. Within the RBV theory, the model shows that there is not a statistically significant link from ERP use to ERP value (H6) ($\hat{\beta} = 0.07;$ p>0.10), and thus H6 is not confirmed. In surn, Analytics (H7) ($\hat{\beta} = 0.29;$ p<0.01), Collaboration (H8) ($\hat{\beta} = 0.44;$ p<0.01), and Firm Size (H9) ($\hat{\beta} = 0.25;$ p<0.01) have a positive and statistically significant path to ERP value. Therefore H7, H8, and H9 are confirmed.

The results for the service industry, without parentheses, are summarized as follows. An examination of R^2 as a descriptive measure shows that the research model explains 49.8% of ERP use and 59.4% of ERP value. Within the Technological context, Training (H1) ($\hat{\beta} = 0.13$; p<0.10) has a significant and positive path to ERP use, while Compatibility ($\hat{\beta} = 0.08$; p>0.10) is not statistically significant. Thus, H1 is confirmed, while H2 is not. Within the Organizational context, Firm Size (H3) ($\hat{\beta} = 0.35$;p<0.01) and Best-Practices (H4) ($\hat{\beta} = 0.15$; p<0.10) are both statistically significant in explaining ERP use, and therefore H3 and H4 are confirmed. Within the Environmental context Competitive Pressure (H5) ($\hat{\beta} = 0.21$; p<0.01) is statistically significant and has a positive path to explain ERP use. Thus, H5 is confirmed. Within the RBV theory, the model shows that there is not a statistically significant link from ERP use to ERP value (H6) ($\hat{\beta} = 0.03$; p>0.10), and thus H6 is not confirmed. In turn, Analytics (H7) ($\hat{\beta} = 0.53$; p<0.01), Collaboration (H8) ($\hat{\beta} = 0.31$; p<0.01) ,and Firm Size (H9) ($\hat{\beta} = 0.18$; p<0.10) have positive and statistically significant paths to ERP value. Therefore, H7, H8, and H9 are confirmed.

In a deeper analysis, the differences between the statistically significant path coefficients across Manufacturing and Services subsamples were tested, based on Keil et al.'s (2000) formula:

$$t = \frac{\beta_{(1)} - \beta_{(2)}}{\sqrt{\frac{(n_{(1)}-1)^2}{n_{(1)}+n_{(2)}-2} \cdot se^2_{\beta_{(1)}} + \frac{(n_{(2)}-1)^2}{n_{(1)}+n_{(2)}-2} \cdot se^2_{\beta_{(2)}}} \cdot \sqrt{\frac{1}{n_{(1)}} + \frac{1}{n_{(2)}}}}$$

Table 4 shows that regarding ERP value, Analytics is a more important factor amongst Service firms than amongst Manufacturing firms.

Table 4 - Results of manufacturing and services subsamples and t-tests for the difference in paths between subsamples

	Manufacturing Path Coeff.	**Service Path Coeff.**	**Comparison (Mfg vs Sev) Two-tailed test**	***p-value***
ERP use				
Training → ERP use	ns	0,13*	-	-
Compatibility → ERP use	0.31**	ns	-	-
Firm Size → ERP use	0.47***	0.35***	1.08	0.28
Best-Practices → ERP use	0.13*	0.15*	-0.18	0.86
Competitive → ERP use	0.19***	0.21***	-0.15	0.88
ERP value				
ERP use → ERP value	ns	ns	-	-
Analytics → ERP value	0.29***	0.53***	-2.25**	0.02
Collaboration → ERP value	0.44***	0.31***	1.31	0.19
Firm Size → ERP Value	0.25***	0.18*	0.60	0.55

Note: *p<0.10, **p<0.05, ***p<0.01; ns – non-statistically significant results.

Overall, the above results provide support for the cross-industry differences in the determinants shaping ERP use (in the Technological context Training is important only for the service industry, and Compatibility is important only for the service industry), and for ERP value (Analytics is more important for the service industry), thereby confirming H10.

6. DISCUSSION

The results show that Training (H1) is not as important in manufacturing as it is in the services industry. This does not necessarily mean that the manufacturing industry disregards user training. SMEs' training is essentially informal and a reactive response to short-term issues (Jayawarna, Macpherson, & Wilson, 2007) and manufacturing firms are significantly influenced by this preference (Matlay & Hyland, 1997). Thus, the lack of a formal and consistent training programme is a barrier to correctly assessing the contribution of user training to the effective utilization of ERP. Also, the manufacturing industry has been using systems such ERP for a longer period, and usually in more capital and human intensive ways, and also with a pool of experience that is more widely available (Tan, Chong, Lin, & Eze, 2010). As a result, the greater number of expert users and trainers reduces the importance of training. While training might be a commodity for the manufacturing industry, the services SMEs have greater difficulty in hiring qualified IT experts, probably because of their scarcer financial resources. IT skills are thus likely to be rarer in Service firms and to become a source of competitive advantage amongst competing SMEs (Uwizeyemungu & Raymond, 2011). Furthermore, the intangible nature of the output of services gives to both information technologies and to human resources a central role in a firm's activities. In the service industry, knowledge itself is the product and human capital is the dominant form of capital (Johnson, Baldwin, & Diverty, 1996). Therefore, the important role played by the human factor in the firm and delivery of services is associated with substantial investment in training (Botta-Genoulaz & Millet, 2006).

Compatibility (H2) is not as important for services as it is for the manufacturing industry. Manufacturing firms tend to insure the extension of software licenses, portability to other technological platforms, and evolving compatibility. Therefore, system compatibility becomes an important driver for system use, as manufacturing firms have to deal with the result of long-term planning (e.g. legacy systems, complex future upgrades, using other specialized packages) (Schäfermeyer, Rosenkranz, & Holten, 2012; Uwizeyemungu & Raymond, 2011). The easier it is to integrate new IT systems with those retained, the more it will contribute to IT use, increasing the

reliability and effectiveness (Wang, Wang, & Yang, 2010; Zhu et al., 2004). Furthermore, these systems tend to have a long life cycle in organizational use, and their processes have been extended into external organizations across the industry value chain (Shang & Wu, 2004). Because services are simultaneously produced and consumed, there is not the same need for inventories, storage, transportation, and supplying as for manufacturing firms (Frohlich & Westbrook, 2002). So, manufacturing firms not only have to consider their own ERP system, they must face more challenges in terms of IT compatibility and integration alongside a wider network throughout the supply chain.

Firm Size (H3) is a facilitator of ERP use in both industries. Although literature reports Firm Size as a controversial predictor of IT adoption (Oliveira & Martins, 2010b), our study confirms that larger firms have more resources and greater capacity for risking investment in adopting, implanting, and therefore, using ERP (Thiesse et al., 2011), while the smaller firms seem less likely to adopt an IT innovation, as they lack the resources needed for construction of knowledge, implementation, and testing (Thiesse et al., 2011).

Consistent with some studies (Maguire et al., 2010; Ruivo et al., 2012), Best Practices (H4) is a facilitator for ERP use amongst SMEs in both industries. Firms that implement industry best-practices dramatically reduce risk and time-consuming project tasks such as configuration, documentation, testing, and training. ERP best-practices seem to maximize the benefits from the implementation, contributing to ERP use.

The result show that Competitive Pressure (H5) is a facilitator for ERP use in both industries. This is in line with literature (Zhu et al., 2004; Zhu et al., 2003), thus showing that not only does ERP provide fundamental benefits, but when a firm embarks upon an ERP implementation, other industry players feel the pressure to eliminate their competitor's advantage as soon as possible. Therefore, pressure from competitors increases the urgency of improving organization performance and leads to more use of the ERP.

Surprisingly, the findings suggest that ERP use is not important to understand ERP value (H6) in either industry. Manufacturing and services firms have been the major targets of ERP vendors, by which it is plausible to assume that through ERP utilization, both sectors have gained a specific resource that guides both internal and external collaboration and provides a data repository to perform business analyses. Therefore, with further utilization, the perception of ERP success use drops, while increasing the necessity of collaboration, to serve new possibilities for using information to improve business processes, and to use operational data to generate reports that support decision-making and resource planning. This finding enhances earlier studies (DeLone & McLean, 1992; Zhu & Kraemer, 2005) to suggest that system utilization should not be studied in isolation. More precisely, our study shows that when system use is positioned together with other organizational system factors, it does not influence the IT value.

In line with this, Analytics (H7) contributes to value creation of ERP in both industries. ERP systems priority is improving transaction handling through the standardization of business processes and integration of operations and data, allowing for consistent and unified internal data (Davenport, 2000). We can assume that the manufacturing and services industries are using the analytical capability features of ERP to create new resources and capabilities in response to changing market conditions, thereby leading to a competitive advantage. In a further analysis (Table 4), our findings indicate that the analytical capabilities of the ERP are more important for services than manufacturing firms. This does not mean that the manufacturing industry disregards the potential contribution of analytics to improve business decisions, but the service industry is more information-intensive in nature, requiring more analytical processing and distribution of information than manufacturing (Uwizeyemungu & Raymond, 2011).

Collaboration (H8) contributes positively to ERP value in both industries. A firm's competitive advantage resides in its ability to leverage collaboration along its supply chain and transform existing business processes (Horvath, 2001). Since ERP is a tool

that helps companies to cut costs and improve efficiency by integrating business processes and sharing common resources across an organization (Jones, Cline, & Ryan, 2006), it becomes a fundamental resource to optimize processes at every network node of the manufacturing and service industries' value chain.

Firm size (H9) is an important determinant for the value creation of ERP in both industries. ERP implementation is a complex, expensive, and time consuming project (Davenport, 1998). Considering that larger companies have more resources and greater capacity for risking such an investment, they are more likely to adopt and use ERP, understand its capabilities, and can apply the benefits to the firm's business, thereby extracting value in an effective way.

Managerial implications

The principal role of manufacturing is to turn physical raw materials into tangible products. Service, on the other hand, generally implies an act and may also provide a "product", but one that is often intangible and cannot be described in the same dimensional terms as manufactured goods (Botta-Genoulaz & Millet, 2006). Thus, the major differences rely in the relative weight of information and customer service (for the service industry) and goods (for the manufacturing industry) in the value creation of operational processes. This makes it especially important for vendors and managers to understand that each industry has different needs that will require different implementation methodologies and systems functionalities based on standard best-practices.

Academic implications

This study has important implications for theory. Firstly, the present research incorporates three distinct contexts (Technology, Organization, and Environment) to understand which determinants influence ERP use, and RBV to understand ERP value. The research model has been verified for reliability, validity, and discriminant tests, and can be used in related studies in the future. Secondly, to the best of our

knowledge no earlier studies have focused on the difference in specific industries to analyse ERP use and value. Thus, this study can serve as a guide for researchers considering what factors are most important for using ERP and extracting value from it, according to the specificities of the industry itself. Lastly, as SMEs account for a significant portion of the European economy, this study also contributes to a better understanding of ERP post-adoption stages in SMEs, regarding two important industries.

7. CONCLUSION

In this study we identify the determinants of Enterprise Resource Planning (ERP) use and value. Grounded on the Technology-Organizational-Environment (TOE) framework and the Resource Based View (RBV) theory, we developed and tested a research model for assessing ERP use and value at the firm level. It was tested using a sample of 261 Iberian Small and Medium Enterprises (SMEs) from the manufacturing and service industries. The study demonstrates that for the manufacturing industry Compatibility is the most important facilitor of ERP use, while in the service industry Training is the most important. In both industries Firm size, Best-practices, and Competitive pressure are important facilitators for ERP use. Additionaly, Analytics, Collaboration, and Firm size are important determinants for ERP value, although Analytics is more important for the service industry. This study also shows that when ERP use is positioned together with other organizational system factors such as Collaboration and Analytics, ERP use loses its influence in explaining the ERP value.

8. LIMITATIONS AND FUTURE WORK

As this study does not take into account the number of years using ERP, further research could be extended to the maturity stages of ERP amongst these two industries. Moreover, although our data cover two specific industry types, we cannot speak empirically about the issue of different industries that have different operating characteristics and environments, and the factors related to ERP use and value may differ. An interesting study would be to compare other industries.

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APPENDIX A - MEASUREMENT ITEMS

Constructs	Items	Literature support
Using a five-point scale, where 1 means "low" and 5 "high", respondents were asked to rate their perception		
Training	Please rate the degree to which . . . TN1 . . . are being trained on the system TN2 . . . understand the content training material TN3 . . . navigate through the topic formats applied to daily tasks	(O'Leary, 2000, Bradford and Florin, 2003, Maguire et al., 2010, Ruivo et al., 2012)
Compatibility	Please rate the degree to which . . . CB1 . . . your ERP system is compatible with others' software CB2 . . . your ERP system is compatible with others' hardware CB3 . . . your ERP system is compatible with others' Networks	(Bradford and Florin, 2003, Elbertsen and Benders, 2006, Ruivo et al., 2012)
Firm Size	S1 – The number of company employees (#) S2 – Annual Business Volume (€)	(Chwelos et al., 2001, Zhu et al., 2006)
Best practice	Please rate the degree to which training programme make sure users . . . BP1 . . . to which users set up the application BP2 . . . to which one can map workflows based on local requirements BP3 . . . of system adaptability to business needs	(Chou and Chang, 2008, Wenrich and Ahmad, 2009, Maguire et al., 2010, Ruivo et al., 2012)
Competitive Pressure	According to ERP usage how . . . CP1 . . . your firm has experienced competitive pressure to use ERP CP2 . . . your firm would have experienced competitive disadvantage if not adopted ERP CP3 . . . the ERP usage in your firm's competitors affects your landscape market	(Bradford and Florin, 2003, Zhu and Kraemer, 2005, Oliveira and Martins, 2010b, Ruivo et al., 2012)
ERP Use	According to users, please rate the degree of how easy it is for them . . . ERPU1 . . . many employees use the system daily? (#) ERPU2 . . . much time per day do employees work with the system? (%) ERPU3 . . . many reports are generated per day? (%)	(Bradford and Florin, 2003, Zhu and Kraemer, 2005, Ruivo et al., 2012)
Analytics	Please rate the degree of ERP impact on . . . AN1 . . . comprehensive reporting (KPIs, Dashboards, etc.) AN2 . . . real-time access to information AN3 . . . data visibility across departments	(Davenport and Harris, 2007, Chiang, 2009, Ruivo and Neto, 2011, Ruivo et al., 2012)
Collaboration	According to ERP system, please rate the degree of . . . CO1 . . . collaborate with colleagues CO2 . . . collaborate with the system CO3 . . . communicate with suppliers, partners, and customers	(Gattiker and Goodhue, 2005, Ruivo and Neto, 2011, Ruivo et al., 2012)
ERP Value	Please rate the degree of ERP impact on… ERPV1 . . . user satisfaction ERPV2 . . . individual productivity ERPV3 . . . sales growth ERPV4 . . .customer satisfaction ERPV5 . . . management control	(Bradford and Florin, 2003, Devaraj and Kohli, 2003, Zhu and Kraemer, 2005, Ruivo et al., 2012)

Notes: Respondents' types were: CEO, owner, IT/IS manager, finance manager, sales manager, and manufacturing manager; TN1, BP2, ERPV1 and ERPV3 question-items were excluded after PLS model estimation due to low loadings

APPENDIX B - PAPER PRESENTED AT CISTI 2013 CONFERENCE

ERP Use in the Manufacturing Sector

The case of Iberian SME

Jorge Rebelo
ISEGI, Universidade Nova de Lisboa
Lisbon, Portugal
j08rebelo@gmail.com

Pedro Ruivo
ISEGI, Universidade Nova de Lisboa
Lisbon, Portugal
pruivo@isegi.unl.pt

Tiago Oliveira
ISEGI, Universidade Nova de Lisboa
Lisbon, Portugal
toliveira@isegi.unl.pt

Abstract - **Enterprise Resource Planning (ERP) system literature lacks research on post-adoption stages, that is, actual usage. even less studies focus on the specificities of an industry analysis. Based on the Technology-Organizational-Environment (TOE) framework, the present study develops a research model to measure and examine determinants of ERP Use in regards to the impact on Iberian Manufacturing Small Medium Enterprises (SME). Hypotheses are postulated based on five determinants (Training, Compatibility, Firm size, Best-practices and Competitive pressure). Testing was conducted through structural equation modeling, utilizing data from 158 web-surveyed firms in Portugal and Spain of the Manufacturing sector. Results showed that all determinants contribute to explain "ERP Use" except Training. The paper provides insight on which determinants contribute for ERP use in Manufacturing Iberian SME, offering managerial and academic implications.**

Keywords: ***ERP; SME Use; Manufacturing; Technology-Organization-Environment Framework.***

I. INTRODUCTION

Enterprise Resource Planning (ERP) systems have been applied by many firms around the world as a key part of the organizational infrastructure. ERP encompass a wide range of software products supporting day-to-day business operations and decision-making [1]. These systems tend to have a long life cycle in organizational use, and their processes have been extended into external organizations across the industry value chain [2]. ERP systems are expected to provide, seamless integration of processes across functional areas with improved workflow, standardization of various business practices, improved order management, accurate accounting of inventory, and better supply chain management [3]. The ERP are particular important for manufacturing SME [4]

The manufacturing sector is one of the main economic activities in European Union [5]. Several authors [6-8] state that Small Medium Enterprises (SME) are the support of Europe's economy, important for increasing productivity and gaining competitive advantage in the global economy, as well important drivers of innovation and transformation.

Literature reveals that little attention has been given to research on ERP in SME, and even less on specific industries such as manufacturing [9]. To fill this gap we develop a conceptual model based on Technology–Organization-Environment (TOE) framework to explain "ERP use". To test the conceptual model we collected data from Portugal and Spain manufacturing SME (158 firms). The methodology is presented in Section IV, followed by results, discussion and a summary conclusion.

II. RESEARCH BACKGROUND

A. ERP System Adoption in Manufacturing Firms

ERP systems have traditionally been used by capital-intensive industries, such as manufacturing [10]. Manufacturing firms are facing new challenges and in order to stay competitive, and therefore Information Technology (IT) is now indispensable to many manufacturing operations [11]. Recent findings reveal that in the European context the most important aspect to characterize IT adoption is the industry and its specific characteristics rather than the country the firms belong to [12]. Different industries have different operating characteristics and environments, and the factors related to ERP use may differ accordingly [13, 14]. Given the specificity and complexity of manufacturing firms, we explore which aspects of a firm's context influence the use of technological innovations.

B. Adoption Models

One of the most important adoption model at firm level is TOE framework [15]. TOE framework is a well-established framework that encompasses various contexts with which IT adoption can be assessed, and it has been examined by a number of studies on various Information System (IS)

domains [16-19]. The TOE framework identifies three aspects of a firm's context that influence the process by which it adopts and implements technological innovation: (a) Technological context – which describes both the internal and external technologies relevant to the firm; (b) Organizational context – which refers to descriptive measures about the firm; and (c) Environmental context – that refers to the arena in which a firm conducts its business [20].

III. Research Model and Hypotheses

A. Research Model

Grounded on the TOE framework, it was developed a conceptual model to assess the use of ERP systems (Figure 1). The extent of "ERP use" is defined by determinants within the three contexts of the TOE: Technology context (Training and Compatibility), the Organizational Context (Firm Size and Best Practices), and the Environmental context (Competitive Pressure).

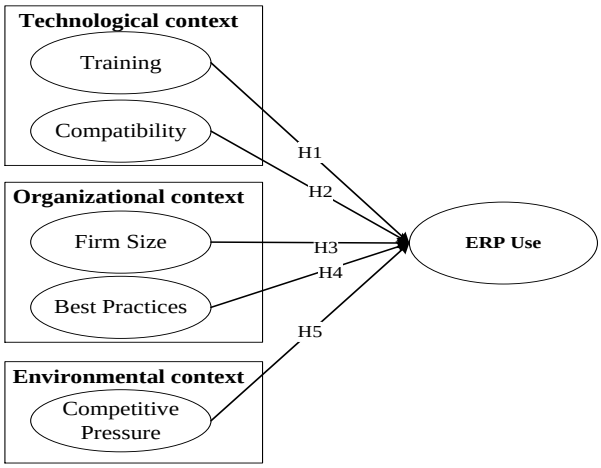


Figure 1. Research Model

B. Hypotheses

- Technology Context

According to Tornatzky and Fleischer [20] a firm with higher quality of human resources, such as better education or training, will have higher ability in technological innovation. Thus, literature shows that training is an important factor for IT implementation success and furthermore for successfully adopting, using, and benefiting from ERP systems [21-23].

H1. The level of firms training program will have a positive relationship with ERP use.

Compatibility has been shown to be an important factor to explain innovation use by organizations, thus high compatibility has been identified as a facilitator for innovation adoption [24, 25]. Bradford and Florin [22] findings indicate that the degree of compatibility of ERP systems with existing IT infrastructure will have a positive relation with successful adoption and use.

H2. Firms having ERP systems with greater compatibility are more likely to use ERP.

- Organizational Context

Larger firms have an advantage over smaller ones, as they have more resources and can take greater risks associated with innovation adoption [26]. Smaller firms although more versatile, do not readily adopt newer technologies [27].

H3. Firm Size will positively influence ERP Use.

The business processes implicit with the ERP system are purported to represent "best practice" and a more competitive business model [28]. According to [8, 23] firms that implement industry best-practices dramatically reduce risk and time-consuming project tasks such as configuration, documentation, testing, and training.

H4. Firms with a greater degree of business process fit to standard ERP "best-practices" are more likely to use ERP.

- Environment Context

Competitive pressure refers to the degree of pressure from competitors, which is an external power pressing a firm to adopt new technology in order to avoid competitive decline [24]. Several studies determined Competitive Pressure is an IT adoption and use driver [24, 29].

H5. Firms facing higher competitive pressure are more likely to achieve a greater extent of ERP use.

IV. Method

A. Measurement

The constructs were developed based on literature (Appendix). All constructs were measured using a five-point Likert scale, with the anchors being "low" and "high". All item-question were translated into the two languages and reviewed for content validity by a panel of five established academic IS researchers and two language experts. The initial questionnaires were pilot tested on ten firms, and some items were revised for clarity. With the assistance of International Data Group (IDC), questionnaires were sent only to firms that adopt ERP in conducting their business. To ensure the generalization of the survey results, the sampling was stratified by country, and by firm size. The control variables used were country, once that firm size is one independent variable (H3) in the model.

B. Participants and Data Collection

Data was collected using an online survey over a two-month period (September-October 2011). 1400 Iberian companies were contacted and 558 completed responses were received. The sampling was stratified by country (Portugal and Spain), by firm size (fewer than 250 employees), and by industry, resulting in a final sample of 158 Manufacturing. The respondents were qualified individuals (e.g., Chief Executive Officer (CEO), Chief Financial Officer (CFO), and functional managers) to speak about the company's ERP, which suggests a good quality of the data. The profile of the sample is shown in Table I.

TABLE I. SAMPLE CHARACTERISTICS

Respondent Type	**Manufacturing (*N*=158)**	
	Frequency (%)	*Cumulative (%)*
CEO	24%	24%
Manufacturing Manager	30%	54%
Finance Manager	15%	69%
IT/IS Manager	17%	86%
Sales Manager	14%	100%

V. RESULTS

Structured Equation Modeling (SEM) was used to empirically assess the research model (Figure 1). It was performed the Kolmogorov-Smirnov test and confirmed that none of the items measured are distributed normally (p<0.001). For this reason we use Partial Least Square (PLS) since it does not require a normal distribution [30]. PLS estimation requires ten times the largest number of structural paths directed at a particular construct in the model [31]. The sample in our study met the necessary conditions for using PLS.. The specific tool used was SmartPLS 2.0[32] . Using the SmartPLS software, it was first examined the measurement model to assess reliability and validity before testing the structural model.

A. Measurement Model

The results of the measurement model (reliability, validity, correlations and factor loading) are reported in Tables II and IV. We assessed construct reliability, indicator reliability, convergent validity, and discriminant validity. The construct reliability was tested using the composite reliability coefficient. PLS prioritizes indicators according to their individual reliability. As shown on Table II, all the constructs have a composite reliability above 0.7 which suggests that the constructs are reliable [33].

TABLE II. CORRELATION MATRIX, CR AND SQUARE ROOT OF AVE

Constructs	**CR**	**1**	**2**	**3**	**4**	**5**	**6**
Training (1)	0.94	**0.95**					
Compatibility (2)	0.92	0.24	**0.90**				
Firm Size (3)	0.91	0.20	-0.09	**0.92**			
Best Practices (4)	0.81	0.53	0.28	0.18	**0.83**		
Competitive Pressure (5)	0.85	0.30	0.09	0.37	0.34	**0.80**	
ERP Use (6)	0.83	0.38	0.34	0.55	0.41	0.46	**0.79**

Notes:(1) First column (CR) is Composite Reliability;(2) Diagonal elements are square root of Average Variance Extracted;(3) off-diagonal elements are correlations

TABLE III. LOADINGS AND CROSS-LOADING

Constructs		**TR**	**CB**	**Size**	**BP**	**CP**	**USE**
Trainning	TN2	**0.95**	0.29	0.40	0.22	0.33	0.45
	TN3	**0.90**	0.21	0.24	0.23	0.28	0.31
Compatibility	SC1	0.30	**0.97**	0.04	0.33	0.23	0.32
	SC2	0.33	**0.96**	0.06	0.31	0.26	0.34
	SC3	0.05	**0.74**	-0.20	0.19	0.02	0.22
Size	S1Numb	0.27	0.11	**0.87**	0.45	0.43	0.45
	S2VN	0.35	-0.15	**0.83**	0.16	0.23	0.48
Best Practices	BP1	0.17	0.32	0.08	**0.78**	0.18	0.35
	BP3	0.19	0.15	0.49	**0.76**	0.37	0.34
Competitive Pressure	CP1	0.38	0.27	0.42	0.39	**0.95**	0.50
	CP2	-0.07	0.02	-0.06	-0.06	**0.43**	0.04
	CP3	0.24	0.08	0.33	0.27	**0.91**	0.35
ERP Use	EU1	0.16	-0.08	0.68	0.21	0.20	**0.64**
	EU2	0.36	0.40	0.34	0.45	0.46	**0.86**
	EU3	0.45	0.42	0.34	0.39	0.43	**0.88**

The indicator reliability was evaluated based on the criteria that the loadings should be greater than 0.70, and that every loading less than 0.4 should be eliminated [34]. As shown in Table IV, the loadings (in bold) are greater than 0.7. All the items are statistically significant at 0.001. Overall, the instrument presents good indicator reliability.

Average Variance Extracted (AVE) was used as the criterion to test convergent validity. The AVE should be higher than 0.5 so that latent variable explains more than half of the variance of it indicators [34-36].

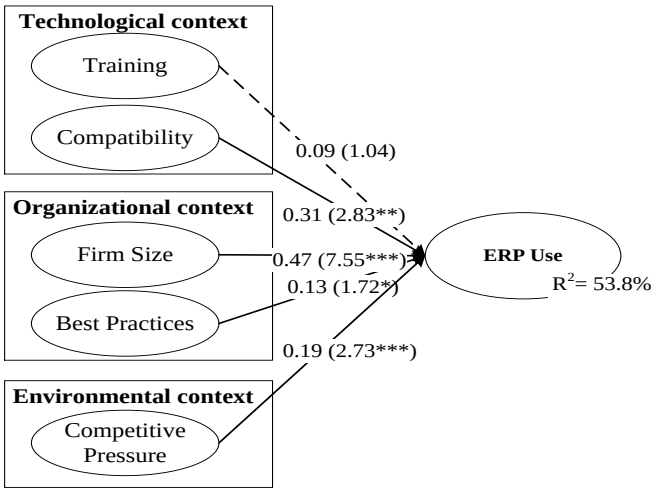
As shown in Table III, all constructs have an AVE higher than 0.5 fulfilling this criterion. Discriminant validity of the constructs was assessed using two measures: Fornell-Larcker criteria and cross-loadings. The first criterion postulates that the square root of AVE should be greater than the correlations between the construct [35]. The second criterion requires that the loading of each indicator should be greater than all cross-loadings [31, 37, 38]. As seen in Table II, the square roots of AVE (diagonal elements) are

higher than the correlation between each pair of constructs (off-diagonal elements). Table III shows that the patterns of loadings are greater than cross-loadings. Thus both measures are satisfied.

The assessment of construct reliability, indicator reliability, convergent validity and discriminant validity of the constructs are satisfactory, indicating that the constructs can be used to test the conceptual model.

B. *Structural Model*

The analysis of hypotheses was based on the examination of the standardized paths. Figure 2 shows the model results. The significance of the path coefficients was assessed by means of a bootstrapping procedure [34, 39] with 500 times resampling [31]. Figure 2 shows the path coefficients and t-statistics (in parentheses) derived from bootstrapping, as well as the R^2 values for dependent constructs.



*Notes: Control variables are Country and Industry; Significance at: *p<0.10. **p<0.05. ***p<0.01*

Figure 2. Conceptual model testing (Manufacturing; *N*=158)

An examination of R^2 as a descriptive measure shows that the research model explains 53.8% of variation in ERP "use". Within the Technological context, while Training (H1) is not statistically significant ($\hat{\beta} = 0.09$; p>0.10), the hypothesis for compatibility (H2) ($\hat{\beta} = 0.31$; p<0.05) has a significant and positive path to ERP use. Thus, Hypothesis H2 is confirmed while Training (H1) is not. Within the Organizational context, Best Practices (H4) ($\hat{\beta} = 0.13$; p<0.10) and Firm Size (H3) ($\hat{\beta} = 0.30$;p<0.01) are both statistically significant in explaining ERP use, therefore hypotheses (H3) and (H4) are confirmed. Within the Environmental context hypothesis Competitive Pressure (H5) ($\hat{\beta} = 0.19$; p<0.01) is statistically significant and has a positive path to explain ERP use. Thus, hypothesis (H5) is supported.

VI. Discussion

Theoretical Implications

This study has significant implications for research on ERP systems. First, to the best of our knowledge no previous studies have focused on Iberian manufacturing industry to analyze ERP use. The present research incorporates three distinct contexts (Technology, Organization and Environment) to understand which determinants influence ERP use. Second, as SEM requires a sample of significant size to attain good rates of adhesion, our study meets this criterion, and it is fair to conclude that the model proposed herein provides a sound basis for understanding the phenomenon evaluated. Third, the study instrument has been verified for reliability, validity and discriminant tests. It can be adopted for use in other related studies. Lastly, this study can serve as a guide for researchers considering what factors are most important for firms to use ERP. Since ERP adoption is a costly and time consuming process, they can compare their results with the findings of this study.

Managerial and Practical Implications

This study focus on identifying the facilitators and inhibitors of ERP use by Iberian SME in the manufacturing sector. An interpretation of the hypothesis testing is summarized below.

Contradicting earlier studies [20-23], the findings suggest that Training (H1) is not an important determinant for ERP Use. This does not necessarily mean that the manufacturing sector disregards user training, but as Tan et al. [40] stated the manufacturing sector is usually more capital and human intensive, with a more generally wider talent pool available. Therefore, a greater number of expert users and trainers reduce the importance of training. A second reason for this finding could be related to the

specificity of SME. Jayawarna et al [41] stated that SME training is essentially informal and reactive response to short-term issues, while Matlay and Hyland [42], found that in small manufacturing firms was significantly influenced by this preference. Thus, the lack of a formal and consistent training program is a barrier to correctly access the contribution of user training to the effective utilization of ERP.

Compatibility (H2) is a facilitator of ERP use. This is consistent with other studies that also identified compatibility as a facilitator of innovation [24, 25]. System compatibility is an important driver for system usage. The easier it is to integrate new IT with the ones retained, more will contribute to its use, increasing the reliability and effectiveness.

Firm Size (H3) is a facilitator of ERP use. Although literature reports Firm Size as a controversial predictor of IT adoption [13], our study confirms that larger firms have more resources and greater capacity for risking investment in an adopting, implanting and therefore, using ERP [26], while SME seem less likely to adopt an IT innovation, as they lack the resources needed for construction of knowledge, implementation and testing [26, 27]. This results, might be especially important for CEO who believe that their company is too small to use and benefit from ERP.

Consistent with literature [8, 23], Best Practices (H4) is a facilitator for ERP use. firms that implement industry best-practices dramatically reduce risk and time-consuming project tasks such as configuration, documentation, testing, and training. ERP best practices seem to maximize the benefits from the implementation, contributing to ERP use.

The result shows that Competitive Pressure (H5) is a facilitator for ERP use. This results is in line with literature [24, 29], thus showing that not only ERP provides fundamental benefits, but when a firm embarks upon an ERP implementation, other industry players feel the pressure to eliminate their competitor's advantage as soon as possible. Therefore, pressure from competitors increases the urgency of improving organization performance and leads to the use of ERP.

Limitations and Future Work

This paper has some limitations that may form the starting point for further research. First, although the study focuses on ERP use, we did not study the value stage and therefore we can not speak about a direct link between ERP use and ERP value. This study does not take in account the number of years using ERP, and therefore an interesting different direction could be to study the maturity stages of ERP. Our study focus on Iberian manufacturing SME and it would be interesting to explore as well how culture influences on ERP use, extending the study to other regions. Second, although data covers one specific industry types, we cannot speak empirically on the issue of different industries have different operating characteristics and environments, and the factors related to ERP use may differ. An interesting study would be to compare industries.

VII. CONCLUSION

ERP have become one of the most important developments in the corporate use of IT, as they lead to the realization of substantial tangible and intangible improvements in a variety of areas. This study intended to identify the determinants of ERP use. In the Iberian context the most important aspect to characterize IT adoption is the industry and its specific characteristics. Grounded on TOE framework we developed and tested a research model for assessing ERP use at firm level. It was tested using a sample of 158 Iberian firms from the manufacturing sector. The study demonstrate that the Technology context (Compatibility), Organizational context (Firm Size and Best Practices) and the Environment context Competitive Pressure) are important facilitators of ERP use in Manufacturing Iberian SME.

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APPENDIX. MEASURE ITEMS

Constructs	Items	Literature support
Using a five-point scale, where 1 means "low" and 5 "high", respondents[a] were asked to rate their perception		
Training	Please rate the degree to which training program make sure users . TN1 . . . are being trained on the system[b] TN2 . . . understand the content training material TN3 . . . navigate through the topic formats applied to daily tasks	O'Leary [21], Bradford and Florin [22] and Maguire et al. [23]
Compatibility	Please rate the degree to which . CB1 . . . your ERP system is compatible with others' software CB2 . . . your ERP system is compatible with others' hardware CB3 . . . your ERP system is compatible with others' Networks.	Bradford and Florin [22] and Elbertsen et al. [43]
Firm Size	S1Numb – The number of company employess (#) S2VN – Annual Business Volume (€)	Chwelos et al. (2001), Premkumar and Roberts (1999) and Zhu et al. (2006)
Best practice	Please rate the degree.. BP1 . . . to which users set up the application BP2 . . . to which one can map workflows based on local requirements (such as VAT, intercompany posting)[b] BP3 . . . of system adaptability to business needs	Wenrich and Ahmad[44] and Maguire et al. [23]
Competitive Pressure	Please rate the degree. . . CP1 . . . your firm has experienced competitive pressure to use ERP CP2 . . . your firm would have experienced competitive disadvantage if ERP had not been adopted CP3 . . . the ERP usage in your firm's competitors affects your landscape market	Bradford and Florin[22], Zhu and Kraemer[18] and Oliveira and Martins[13]
ERP Use	According to ERP usage how . . . EU1 . . . many employees use the system daily? (#) EU2 . . . much time per day do employees work with the system? (%) EU3 . . . many reports are generated per day? (%)	Bradford and Florin[22], Zhu and Kraemer[18] and Oliveira and Martins[13]
Notes: [a]Respondents types were: CEO, owner, IT/IS manager, finance manager, sales manager and manufacturing manager; TN1, and BP2 were excluded after PLS model estimation due to low loadings		